results there stated were found useful in discussing the latitude observations. The detailed investigation will appear in print as a special publication of the U. S. Coast and Geodetic Survey (no. 80); a shorter account appeared in the *Journal of the Washington Academy of Sciences*, January 19, 1922.

7. Mr. English said that the general trend of all opinion in the world seems to be a fluctuating one. The attitude towards mathematics is no exception, as to importance of methods of study and content of courses. The western part of the United States seems now to be dominating the eastern part, though it is not any too sure of itself. The reorganization which it is zealously pushing has many good features, though seemingly only one year of high school mathematics is required and that is somewhat polyglot in its nature. It may well apply to a junior high school course if that is a school of completion, but if it is to be the universal preparation for all senior high school mathematics, there is real danger along the line through the high schools and up into the colleges. There is naturally a haziness about the upper years, which may result fatally, especially in the hands of the majority of teachers, as definite details must be given if no harm is to result to pupils going from one teacher to another. It is a case of making haste slowly, giving careful consideration to all factors involved.

8. Dr. L. M. Kells first reviewed the well-known theory for minimal curves in the plane and in space, and then showed that the general equations of minimal curves in 4-space are

$$x_1 = \tfrac{1}{2}[(\lambda^2 - 1)F_1''(\lambda) - 2\lambda F_1'(\lambda) + 2F_1(\lambda) + i\{(\lambda^2 + 1)F_2''(\lambda) - 2\lambda F_2'(\lambda) + 2F_2(\lambda)\}],$$

$$x_2 = -\tfrac{1}{2}i[(\lambda^2 + 1)F_1''(\lambda) - 2\lambda F_1'(\lambda) + 2F_1(\lambda) + i\{(\lambda^2 - 1)F_2''(\lambda) - 2\lambda F_2'(\lambda) + 2F_2(\lambda)\}],$$

$$x_3 = \lambda F_1''(\lambda) - F_1'(\lambda),$$

$$x_4 = \lambda F_2''(\lambda) - F_2'(\lambda),$$

where $F_1(\lambda)$ and $F_2(\lambda)$ are arbitrary functions of λ and the primes indicate derivatives with respect to λ. Properties in 4-space analogous to those for ordinary space were considered.

G. R. CLEMENTS, *Secretary-Treasurer.*

THE APRIL MEETING OF THE OHIO SECTION.

The seventh regular meeting of the Ohio Section was held in the Physics Building, Ohio State University, Columbus, on April 14–15, 1922, in connection with the meetings of the Ohio College Association and allied societies. An afternoon and an evening meeting were held on Friday. On Saturday a joint meeting of two sessions with the Ohio members of the Society for the Promotion of Engineering Education was held. Chairman B. F. Yanney presided, being relieved by Professor K. D. Swartzel for an interval.

There were fifty-three persons in attendance, including the following thirty-three members of the Association:

R. B. Allen, W. E. Anderson, G. N. Armstrong, C. L. Arnold, C. B. Austin, Grace M. Bareis, R. D. Bohannan, E. H. Clarke, H. L. Coar, O. L. Dustheimer, T. M. Focke, Emma L. Konantz, H. W. Kuhn, W. C. McCoy, E. S. Manson, Jr., C. C. Morris, Amy F. Preston, S. E. Rasor, P. L. Rea, Hortense Rickard, Bernice Sanders, R. A. Sheets, Mary E. Sinclair, S. A. Singer, K. D. Swartzel, T. E. Trott, J. H. Weaver, C. E. White, R. B. Wildermuth, F. B. Wiley, C. O. Williamson, B. F. Yanney, and Antioch College represented by Dean P. C. Nash.

At the business session, the secretary reported a membership of seventy-eight and nine institutional members as against sixty-eight and eight, respectively, last year. Officers elected for this year are: Chairman, Professor H. L. COAR, Marietta College; Secretary-Treasurer, Professor G. N. ARMSTRONG, Ohio Wesleyan University; Third member of the executive committee, Professor J. H. WEAVER, Ohio State University. A committee of seven was elected with power to appoint and organize six or more sub-committees, to investigate the mathematics situation in Ohio with respect to the following six aspects at least: the state requirements and privileges, elementary school courses, high school courses, college entrance requirements, college courses, and teacher-training. This committee is to bring in a report, with recommendations, at the next annual meeting of the Section.

A majority of those in attendance joined with the Ohio College Association in the evening dinner at the Ohio Union, which was followed by an address by Dr. Thomas S. Moran, Purdue University.

The following papers were presented at the three sessions:

(1) Chairman's Address: "Some aspects of the mathematical situation in Ohio" by Professor B. F. YANNEY;

(2) Discussion: Professor E. H. CLARKE and Professor F. E. LANDSITTEL, Supervisor of High Schools, Ohio State University;

(3) "Chinese algebra, 'the precious mirror of the four elements'" by Professor EMMA L. KONANTZ;

(4) "The high school-college problem" by Miss MARIE GUGLE, Assistant Superintendent of Schools, Columbus (by invitation);

(5) "Simplification of the proofs of two statistical formulæ by the use of the calculus: (*a*) the moment formula, (*b*) the line of regression" by Professor C. C. MORRIS;

(6) "A theorem in geometrical optics" by Professor J. H. WEAVER;

(7) "The mathematical justification of a fundamental postulate of the theory of relativity" by Mr. DIO L. HOLL, Ohio State University (by invitation);

(8) Report on the Toronto meeting with special reference to "Research problems for college teachers" by Professor MARY E. SINCLAIR;

(9) "Structure and style of mathematical text books" by Professor H. L. COAR.

(Joint meeting with the Ohio members of the S. P. E. E.)

(10) "First lessons in calculus for engineering students" by Professor E. F. CODDINGTON, Ohio State University;

(11) "Mathematics and engineering in the Antioch program" by Dean P. C. NASH;

(12) "An experiment in freshman mathematics for engineers" by Professor K. D. SWARTZEL.

(Additional papers by members of the S. P. E. E.)

Abstracts of the papers follow below, the numbers corresponding to the numbers in the list of titles:

1. Chairman Yanney, in his opening address, considered some aspects of the mathematical situation in Ohio, the immediate occasion of the address being the recent ruling of the State Department of Education to the effect that the unit of mathematics, hitherto required as one of the constants in every high school curriculum, is no longer required. The whole situation was reviewed, and it was suggested that a committee of seven be appointed to investigate the situation and to bring in a report with recommendations at the next annual meeting of the Section.

2. (*a*) In his discussion, Professor Clarke called especial attention to a study reported by Marsh in *Educational Administration and Supervision* for November, 1921. Marsh's results seem to indicate conclusively that one year of algebra produces a marked beneficial effect upon a pupil's later work.

(*b*) Professor Landsittel presented the position of the state educational authorities with reference to mathematics in high schools. The elimination of the one-unit requirement in mathematics from the list of constant studies prescribed by the state for high schools is not to be understood as an act in contravention of entrance requirements of the colleges. The indispensability of due preparation in mathematics on the part of entrants to standard college courses is fully recognized. The subject as a requirement is to be waived in general only in the cases of students markedly deficient in mathematical ability but possessing sufficient capacity in other lines to make possible creditable graduation from the high school. In the judgment of the speaker these students are exceedingly limited in number.

3. Professor Konantz discussed the Chinese Algebra of Chu Shih Chieh published in 1303. A short resumé of the foundations upon which Chu had to build and an explanation of the old Chinese methods of computation were followed by a discussion of the four elements and the process of finding the roots of higher degree equations. This process was shown to be precisely the same as Horner's method of root extraction. Chu's arithmetical triangle was shown to be the same as Pascal's triangle. The greatest work of the Chinese mathematicians was in arithmetic and algebra and Chu's "Precious Mirror" shows the height to which they attained.

4. The high school-college problem in mathematics teaching was discussed by Miss Gugle. One difficulty is that there are usually great gaps in the continuity of the subject matter. Another is that instructors consider themselves teachers of algebra or of geometry instead of teachers of mathematics. Also by giving material not suitable to the pupil's needs, the teacher develops in him a

distaste for mathematics so that he loses faith in his own ability. There are too many failures, expensive both to the pupil and to the public. We as teachers must find a way or make way for others who will; for pupils must be trained to succeed, not to fail. Public schools demand that teachers be trained in the art and science of teaching. Colleges, too, must realize that the strongest and best teachers are needed to teach college freshmen. Much can be done when the representatives of high school and college confer and in that way bring about a better mutual understanding.

5. Professor Morris emphasized the importance of a knowledge of the calculus on the part of the student of statistics. He exhibited calculus proofs of certain statistical formulæ, the algebraic proofs of which are complicated and difficult to follow.

6. Professor Weaver, following a suggestion in Pappus's comments on Euclid's *Optics*, showed that if rays of light emanate from two sources in a plane P, such that the rays from the sources form at the eye a constant angle which revolves about an axis parallel to P, then the path of either of the sources is a hyperbola provided the rays are not refracted. If, however, the rays are refracted at a second plane Q, the path of a source in plane P is a curve C of degree 8. He also pointed out some properties of C.

7. Mr. Holl showed that the Newtonian transformation for the uniform rectilinear motion of a light emitting source gives unequal light velocities in opposite directions, a moving point source now generating an elongated spheroid light volume, but in postulating constant light velocity in all directions we have the Lorentz form, out of which arises the invariant D'Alembert form of differential equation for light propagation, and a sphere light volume for a moving source. This puts in mathematical language the second postulate of Special Relativity in which light velocities are invariant. The transformation shows the correction for Newtonian mechanics for uniform rectilinear motion as well as the interdependence of time and space.

8. Professor Sinclair reported the discussions given at the Toronto meeting of the Association by Professors Oswald Veblen and G. A. Bliss. The former centered his discussion about foundations of geometry. He urged that more should be done in developing the assumptions, much of it elementary in character but demanding reflection and imagination. He also questioned whether the study already made might not react more directly on the teaching of geometry. Professor Bliss emphasized the fact that research is the discovery of a problem on which to work. One needs enthusiasm, imagination, and somewhat of mathematical maturity. He spoke of the fertile field of the application of the calculus of variations to problems, many of them calling for methods peculiar to the problem, but often only a moderate amount of the theory. Recent research has applied itself to new problems and also to extensions of the solutions of problems by Newton and his contemporaries. The reviewer concurred with Professor Bliss in recommending the attractiveness of this field, and sketched some problems as typical. (See *1922*, 101–103).

9. Professor Coar spoke on mathematical text books, especially those on elementary subjects. He mentioned that too little emphasis is placed in our books on the use of mathematics as a language and upon its interpretation in terms of everyday life. Elementary texts should be more condensed and not be reference books. In any subject only a few well-defined principles are needed. These should be mastered before statement in the form of rules. Analytic geometry should emphasize analysis. Thus far most texts have failed along this line. In writing elementary texts, we should keep in mind the student rather than the subject-matter.

10. Professor Coddington explained his methods of illustrating the general rate meaning, not time-rate meaning, of a differentiation by means of a few simple numerical problems, before attempting to define differentiation. This is done because it is thought that the student may thus acquire a better appreciation of the meaning of a derivative than from the formal definition in terms of concepts such as function, limit, variable, etc., which he does not understand.

11. In the Antioch experiment the amount of actual engineering taught is reduced from that of the conventional technical school to allow, first, more time for a broad cultural education, and second, more time for general business courses needed by the engineer. The coöperative plan is used to allow the student to get actual experience in his vocation. Outlines of the courses of instruction in various branches of engineering were presented by Dean Nash. One year of mathematics is required of all students. Students are segregated into groups of about equal mathematical ability, and those not competent to handle elementary algebra are required to make up the deficiency, without credit, in the academy. The other students take two weeks for a study of two or three principles of advanced algebra, devoting the rest of the semester to trigonometry. The second semester is spent in a combined study of analytical geometry and business graphs and statistics. These are combined, first, to give something in the actual experience of the student which relates the abstract ideas of analytical geometry, and, second, to give him the power of analyzing business graphs and statistics from a theoretical point of view.

12. In describing an experiment in segregation of freshmen in mathematics in the College of Engineering of The Ohio State University, Professor Swartzel spoke of (*a*) the reasons for making the experiment; (*b*) the ten-lesson review in sub-freshman mathematics preceding the segregation; (*c*) the uniform test and other considerations upon which the segregating classification was based; (*d*) the semester records of the two thirds retained in the freshman mathematics and of the one third reviewing the more advanced portions of sub-freshman mathematics; (*e*) a comparison with the records of previous years showing a decrease in failures and withdrawals from 32 per cent. to 10 per cent. in the case of freshman mathematics and from 32 per cent. to 17 per cent. in the case of the freshman and sub-freshman mathematics combined. There were corresponding and material increases in the numbers passing with higher semester standing.

G. N. ARMSTRONG, *Secretary-Treasurer.*